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Witch Flounder Catch Results from Fall 1999 Survey in NAFO Division 3Ps

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Abstract

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod and flatfish. The focus in this document is witch flounder. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the second GEAC survey to investigate in detail the witch catch (following on the 1998 results in CSAS Research Document 99/59). One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the 1999 trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of witch abundance and biomass, including age distribution estimates, and interpretation of results are presented. The 1999 estimate numbers alone indicate a large increase in estimated abundance and biomass from 1998; however, the stability in the age and growth distributions seen argue against inferring any kind of large population increase, rather it is more likely a year effect that is the cause of the increases. Three large sets from one stratum area account for approximately 75% of the total reported 1999 catch.

Résumé

Pour améliorer la base de données de recherche sur les pêches pour la sous-division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue et des poissons plats effectués en 1997, en 1998 et en 1999, à l'automne. Le présent document porte sur la plie grise. Ces travaux ont pour but d'obtenir une série de relevés annuels d'automne dans la sous-division 3Ps pour compléter les activités actuelles d'évaluation des ressources que mène le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont été analysées pour le compte du GEAC et en vue de transmettre les résultats au MPO pour qu'il les entre dans ses bases de données et s'en serve dans ses travaux d'évaluation. Ce document aborde le deuxième relevé du GEAC qui examine en détail les prises de plie grise (pour donner suite aux résultats de 1998 présentés dans le document de recherche 99/59 du SCES). Une sortie effectuée dans le cadre du relevé de 1999 s'est déroulée du 22 novembre au 2 décembre 1999, ce qui correspond aux périodes de sortie des deux années précédentes, soit du 8 au 17 décembre 1997 et du 30 novembre au 12 décembre 1998. Au cours de la sortie de 1999, les détails de la pêche et les fréquences de longueurs ont été enregistrés dans le système FFS du MPO, et des otolithes ont été prélevés pour la détermination de l'âge. Le document présente des statistiques de captures, la distribution des longueurs et des âges, des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de la répartition par âge, ainsi que l'interprétation des résultats. Considérées seules, les estimations de 1999 indiquent une forte augmentation de l'abondance et de la biomasse par rapport à 1998; toutefois, la stabilité des distributions des âges et de la croissance contredit toute déduction d'une forte hausse de la population. Les augmentations observées seraient sans doute plutôt attribuables à l'effet d'une année exceptionnelle. Les captures découlant de trois grands traits réalisés dans une strate spatiale représentent environ 75 % des prises totales déclarées de 1999.

Introduction

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod and flatfish. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the third such GEAC survey in 3Ps following on the 1997 and 1998 surveys and the second survey in which the witch catches have been investigated in detail (following on CSAS Research Document 99/59 [1]). Interest in this survey was directed at cod, American plaice, and witch flounder (grey sole). The 1999 results for cod and plaice are presented in companion CSAS Research Documents 2000/024 [2] and 2000/025 [3]. One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging.

Under contract to GEAC, AMEC (formerly AGRA Earth & Environmental) has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

Trip 4: Stratified Random Survey
Trip 4 was carried out from 22 November to 2 December 1999. This time period is consistent with the 1997 and 1998 random stratified survey sets. The *Pennysmart*, the same boat as in 1997/98 and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, American plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. No significant weather or sea events were reported that would have adversely affected the trip success.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock hopper foot gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using NETMIND sensors: bridge display of doorspread, wingspread, and net opening (headline height) was visually monitored and measurements were noted

on the written bridge log for each set every five minutes. The trawl gear and configuration were identical to those used in the 1997 and 1998 surveys.

A total of 90 successful stratified random tow sets were completed. Four sets were unsuccessful.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis

The set details and witch length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Bob Ennis. The sole focus in the work presented here is for witch.

The witch were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch numbers and weights were carried out. These are presented in Figures 1 and 2. Table 1 presents a summary of the witch set details and catch numbers and weights.

The mean witch catch for the 90 stratified random sets is 30 fish and a mean catch weight of 12 kg. A catch of witch was reported in 35 of the 90 successful sets. The largest catch of 784 witch and weight 323 kg was from set 78 at the eastern side at the mouth of the Halibut Channel in a depth of approximately 150 m. A total of four sets had catches over 100 kg. The mean witch weight for all sets (total weight/total numbers) was 0.41 kg per witch. The median witch weight of the 35 sets in which witch were caught was 0.38 kg. The mean witch weight for the largest catch set 78 was 0.4 kg.

Gear Performance

The NETMIND wing sensor was lost initially when the tow gear fouled. The ship returned to Marystown for a replacement sensor and repaired the gear. There are no wings values for sets 1 to 18. There are also no measurements for opening for sets 78 onwards.

For the reported sets, doorspread exhibited a large range of values varying from 50 to just under 100 m, generally increasing in value with depth (Figure 3d). Wingspread was fairly uniform with a mean value of 18.5 m (Figure 3a). This wingspread value is consistent with the 1998 NETMIND mean wingspread value and that used in the 1997 survey. Some net parameter measurements were collected by a SCANMAR system in 1997; however, that system performed with some problems in the later sets. No wingspread data are available from that 1997 survey: the 1997 best estimate of 60 feet has been used for all stratified analyses to date. Figures 3b and 3c present trawl depth and bottom temperature for each set. The values are gleaned from the set sheets.

Length and Age

Figure 4 presents the length composition of the 1999 survey and, for comparison, results from the 1998 survey are also shown. For 1999, the fish range in size from 25 cm up to 53 cm. The distribution shows a peak at the mean (38.7 cm), 3-5 cm below the 1998 peak. Other than this downward shift in the peak, in terms of shape, range of values, and peak, the length distribution for the two years are almost identical.

Figures 5a and 5b present age composition of the 1999 sampled witch. Figure 5a presents length versus age distribution. The mean age of 361 sampled witch was 8.9 years. The youngest and oldest fish were 5 and 13 years.

Figure 5b presents a bar chart of the sampled numbers of witch at age for 1999 and 1998. The number of sampled witch are similar for the two years: 295 in 1998; and 361 in 1999. The 1999 distribution shows ages 7 through 11 are the most frequent, each accounting for 12 to 20% of the samples, age 8 being the most common at 20%. Ages 6 and 12 each account for 6 to 8%. The age distributions for the two years are similar: ages 9 for 1998 being 10% greater than that for 1999. Other ages 7 to 11 are within 2 to 3% of each other. At ages 6 and 12 the 1999 numbers are 4 to 6% greater than those for 1999.

Stratified Analysis

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. A wingspread of 60 feet was used. Table 2 presents the STRAP output of estimated abundance and biomass. The estimated total number of witch for 3Ps is 23.7 million (with 95% confidence limits of 0.9 and 46.5 million). The mean number of witch per standard 1.5 nautical mile tow is 28.5 (with limits of 1.1 and 55.9 fish) consistent with the value of 30 in Table 1. The estimated total witch biomass is 9.6 ktonnes. The mean catch weight per tow is 11.5 kg close to the mean of 12.2 in Table 1.

All STRAP estimate values are up from 1998, uniformly by a factor of 5. The 1999 abundance is up five times from the 1998 value of 4.6 million. The 1999 biomass total is also up five times from the 1998 value of 1.8 ktonnes. The mean set catch and weight values are up from 5.6 fish and 2.2 kg in 1998 to 28.5 fish and 11.5 kg in 1999.

It is noted that approximately 75% of the total catch numbers and weights came from seven sets in stratum area 319. This is in comparison to 26% and 32% for the catch numbers and weights in the 1998 survey. Three of the seven sets with catches of 513, 720, and 784 witch comprised the bulk of the stratum 319 representation. Two of the stratum 319 sets had no witch catch.

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 28.3 (consistent with the value in Table 2). The greatest numbers expected are at ages 9 (8.2 fish per tow), 8 (7.2 fish), and 10 (6.2 fish). Two to three fish each at ages 7 and 11 are also expected. Lesser numbers of fish are expected at ages 6 and 12.

Table 3b presents a year class summary comparison of abundance STRAP estimates for 1998 and 1999. The 1999 values are those from Table 3a. A large range of year classes is evident for 1999: 1988 through 1992 are all well-represented. In addition to the noted overall increase in numbers for 1999 over 1998, the 1991 and 1992 year classes are increased from 1998.

Figures 6a and 6b present the STRAP-estimated mean number of fish per tow and the percent occurrence of mean catch numbers per tow. As already noted with the five-fold increase in estimated numbers from 1998 to 1999, Figure 6a illustrates the increase in numbers for all ages and year classes. Figure 6b illustrates that in 1998 there was slightly greater representation for fish aged 9, and 5 and 4. Ages 6, 7, 11, and 13 show similar representation for the two years, while ages 8 and 10 are slightly more prevalent in 1999.

Figures 7 illustrates the percent occurrence of the year classes from the STRAP mean catch per tow estimates. The proportions of 1987, 1988, and 1989 year classes are greater for the 1998 survey, while the proportions of 1990, and especially 1991 and 1992 are greater for the 1999 survey.

While it is difficult to make comparisons due to the difference in gear types employed, and uncertainties as to how the different gear relate, a comparison with DFO research vessel surveys from the mid 1970's to 1999 suggests that the 1999 GEAC biomass estimate is comparable to Campelen gear surveys since the early 1990's and larger than several Engel gear surveys of the same period [4]. Ideally one would like to obtain additional points beyond the two years already in the GEAC survey. Until that point it is difficult to compare and assess trends in the time-series.

Tables 4a and 4b present the witch abundance and biomass estimates by strata for 1998 and 1999, arranged by depth regime. While there are no 1999 witch catches for the two shallow water strata 314 and 320, and as has been already noted, the 1999 witch catches for the 51-100 fathom regime are more than 10 times greater than the 1998 catches, for the other depth regimes the general catch estimates are quite similar between the two years. Stratum 319 contributes 82% to the 1999 biomass estimate.

While increases are evident for a range of year classes, such a general population increase is not biologically possible for the witch species. The stability in the age shape distribution and no apparent change in incoming recruitment (Figures 5b, 6a, 6b) all suggest against inferring any type of large scale increase in spite of the increased estimate numbers. The large increase from 1998 to 1999 appears to be a year effect with temperature, catchability, or population movement factors at play. Other than reporting on the catches and distributions from the survey, it is difficult to draw conclusions on the population.

References

[1] McClintock, J., 1999. "American Plaice and Witch Flounder Catch Results from Surveys in NAFO Division 3Ps." CSAS Research Document 99/59."

[2] McClintock, J., 2000. "Cod Catch Results from Fall 1999 Survey in NAFO Division 3Ps." CSAS Research Document 2000/024."

[3] McClintock, J., 2000. "American Plaice Catch Results from Fall 1999 Survey in NAFO Division 3Ps." CSAS Research Document 2000/025."

[4] DFO, 1999. "Witch Flounder in NAFO Subdivision 3Ps." DFO Science Stock Status Report A2-09 (1999).

M.V. Pennysmart

Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Set Location Long (W)	Witch Catch # of Fish	Witch Catch Weight (kg)	Witch Mean Weight (kg)
49	4	1	99	11	22	322	3P	M29	46.56	55.93	0	0.00	
49	4	2	99	11	23	322	3P	M30	46.40	55.90	0	0.00	
49	4	3	99	11	23	322	3P	M30	46.44	55.70	0	0.00	
49	4	4	99	11	23	322	3P	M30	46.32	55.54	0	0.00	
49	4	5	99	11	23	321	3P	M30	46.17	55.53	0	0.00	
49	4	6	99	11	23	321	3P	M30	46.11	55.59	0	0.00	
49	4	7	99	11	23	321	3P	M30	46.20	55.68	0	0.00	
49	4	8	99	11	23	322	3P	M30	46.29	55.88	1	0.50	0.5
49	4	9	99	11	23	322	3P	L30	46.36	56.10	0	0.00	
49	4	10	99	11	23	320	3P	L30	46.06	56.45	0	0.00	
49	4	11	99	11	23	320	3P	L30	46.08	56.61	0	0.00	
49	4	12	99	11	23	314	3P	L30	46.12	56.49	0	0.00	
49	4	13	99	11	23	314	3P	L30	46.29	56.89	0	0.00	
49	4	14	99	11	23	314	3P	L30	46.37	57.00	0	0.00	
49	4	16	99	11	24	314	3P	K29	46.50	57.01	0	0.00	
49	4	17	99	11	24	314	3P	L29	46.68	56.99	0	0.00	
49	4	19	99	11	24	311	3P	K29	46.80	57.12	0	0.00	
49	4	20	99	11	24	310	3P	K29	46.92	57.09	16	4.00	0.3
49	4	21	99	11	24	310	3P	K29	46.83	57.33	9	3.00	0.3
49	4	22	99	11	24	313	3P	K29	46.73	57.39	7	3.50	0.5
49	4	23	99	11	24	313	3P	K29	46.62	57.51	5	3.50	0.7
49	4	24	99	11	24	713	3P	K30	46.48	57.64	13	3.50	0.3
49	4	25	99	11	24	713	3P	J30	46.24	58.06	12	2.75	0.2
49	4	26	99	11	24	713	3P	K30	46.10	57.91	6	2.00	0.3
49	4	27	99	11	25	713	3P	K30	46.02	57.78	2	0.50	0.3
49	4	28	99	11	25	713	3P	K30	46.12	57.46	2	1.00	0.5
49	4	29	99	11	25	713	3P	K30	46.32	57.50	9	3.00	0.3
49	4	30	99	11	25	705	3P	K30	46.37	57.46	14	5.00	0.4
49	4	32	99	11	25	312	3P	K30	46.29	57.21	0	0.00	
49	4	33	99	11	25	312	3P	K30	46.16	57.06	2	1.00	0.5
49	4	35	99	11	26	322	3P	M30	46.34	55.40	0	0.00	

49	4	36	99	11	26	323	3P	M30	46.03	55.36	0	0.00	
49	4	37	99	11	26	321	3P	M30	46.00	55.43	0	0.00	
49	4	38	99	11	26	321	3P	M31	45.79	55.64	0	0.00	
49	4	39	99	11	26	320	3P	M31	45.83	55.83	0	0.00	
49	4	40	99	11	26	320	3P	L31	45.82	56.13	0	0.00	
49	4	41	99	11	26	320	3P	L31	45.65	56.07	0	0.00	
49	4	42	99	11	26	321	3P	M31	45.66	55.63	0	0.00	
49	4	43	99	11	26	323	3P	M31	45.62	55.23	2	1.40	0.7
49	4	44	99	11	26	315	3P	M32	45.43	55.51	0	0.00	
49	4	45	99	11	27	320	3P	M32	45.46	55.78	0	0.00	
49	4	46	99	11	27	320	3P	L32	45.42	56.05	0	0.00	
49	4	47	99	11	27	315	3P	L31	45.52	56.44	0	0.00	
49	4	48	99	11	27	316	3P	L31	45.59	56.59	69	18.00	0.3
49	4	49	99	11	27	315	3P	L31	45.63	56.46	4	1.00	0.3
49	4	50	99	11	27	317	3P	L31	45.72	56.66	22	7.00	0.3
49	4	51	99	11	27	706	3P	M31	45.72	55.93	33	11.00	0.3
49	4	52	99	11	27	311	3P	K30	46.17	57.12	84	24.00	0.3
49	4	53	99	11	27	705	3P	K30	46.04	57.18	14	4.00	0.3
49	4	54	99	11	27	712	3P	K31	45.74	57.11	4	1.00	0.3
49	4	55	99	11	28	712	3P	K31	45.62	57.20	3	1.50	0.5
49	4	56	99	11	28	712	3P	L31	45.51	56.80	0	0.00	
49	4	57	99	11	28	706	3P	L32	45.44	56.56	15	4.25	0.3
49	4	58	99	11	28	706	3P	L32	45.30	56.43	13	3.50	0.3
49	4	59	99	11	29	322	3P	M30	46.42	55.07	0	0.00	
49	4	60	99	11	29	323	3P	M30	46.14	55.02	0	0.00	
49	4	61	99	11	29	323	3P	N30	46.13	54.85	0	0.00	
49	4	62	99	11	29	323	3P	N31	45.98	54.94	0	0.00	
49	4	63	99	11	29	325	3P	N31	45.75	54.82	0	0.00	
49	4	64	99	11	29	325	3P	N31	45.74	54.98	0	0.00	
49	4	65	99	11	29	319	3P	M31	45.52	55.05	0	0.00	
49	4	66	99	11	29	319	3P	M32	45.44	55.22	2	2.00	1.0
49	4	67	99	11	29	319	3P	M32	45.25	55.30	513	197.50	0.4
49	4	68	99	11	29	319	3P	M32	45.23	55.31	720	308.72	0.4
49	4	69	99	11	29	315	3P	M32	45.25	55.95	0	0.00	
49	4	70	99	11	29	315	3P	L32	45.11	56.09	0	0.00	
49	4	71	99	11	30	317	3P	L32	45.00	56.09	0	0.00	

49	4	72	99	11	30	316	3P	L33	44.92	56.01	254	128.00	0.5
49	4	73	99	11	30	707	3P	M33	44.89	55.76	26	12.00	0.5
49	4	74	99	11	30	708	3P	M33	44.95	55.55	9	4.00	0.4
49	4	75	99	11	30	318	3P	M32	45.06	55.43	4	3.00	0.8
49	4	76	99	11	30	318	3P	M32	45.11	55.24	4	2.00	0.5
49	4	77	99	11	30	707	3P	M32	45.05	55.23	5	2.50	0.5
49	4	78	99	11	30	319	3P	M32	45.19	55.05	784	323.86	0.4
49	4	79	99	11	30	319	3P	N32	45.20	54.81	21	8.00	0.4
49	4	80	99	11	30	708	3P	N32	45.00	54.58	0	0.00	
49	4	81	99	12	1	325	3P	N32	45.35	54.70	0	0.00	
49	4	82	99	12	1	325	3P	N31	45.56	54.77	0	0.00	
49	4	83	99	12	1	325	3P	N31	45.55	54.70	0	0.00	
49	4	84	99	12	1	326	3P	N31	45.77	54.43	0	0.00	
49	4	85	99	12	1	326	3P	N31	45.82	54.38	0	0.00	
49	4	86	99	12	1	325	3P	N30	46.03	54.51	0	0.00	
49	4	87	99	12	1	324	3P	N30	46.28	54.62	0	0.00	
49	4	88	99	12	1	324	3P	N29	46.53	54.61	0	0.00	
49	4	89	99	12	1	324	3P	N29	46.61	54.58	0	0.00	
49	4	90	99	12	2	322	3P	M30	46.44	55.12	0	0.00	
49	4	91	99	12	2	321	3P	M30	46.11	55.98	0	0.00	
49	4	92	99	12	2	320	3P	L31	45.93	56.08	0	0.00	
49	4	93	99	12	2	315	3P	M31	45.56	55.48	0	0.00	
49	4	94	99	12	2	319	3P	M31	45.52	55.37	0	0.00	

Minimum	0.0	0.0	0.2
Maximum	784.00	323.86	1.00
Mean	30.03	12.24	0.41
Median	0.00	0.00	0.38
Standard Error	1.39	0.58	0.00
Total	2703.00	1101.48	14.56
Count	90	90	35

Table 2 Stratified Analysis Estimated Witch Abundance and Biomass

WITCH GEAC 3PS 1999 No Zone
ANALYSIS FOR TRIP 4 1999 VESSEL 49 ICNAF 3P

NUMBERS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	25.00	12.50	9255.	115693.	24.50
311	2	84.00	42.00	17903.	751918.	3528.00
312	2	1.88	0.94	16281.	15264.	1.76
313	2	12.00	6.00	11147.	66882.	2.00
314	5	0.00	0.00	61748.	0.	0.00
315	6	4.00	0.67	52357.	34905.	2.67
316	2	327.93	163.96	11147.	1827715.	16212.86
317	2	20.63	10.31	11620.	119831.	212.70
318	2	8.00	4.00	8715.	34860.	0.00
319	7	2029.26	289.89	66477.	19271304.	134677.47
320	8	0.00	0.00	79988.	0.	0.00
321	7	0.00	0.00	73503.	0.	0.00
322	9	1.00	0.11	94648.	10516.	0.11
323	5	2.14	0.43	47020.	20152.	0.92
324	3	0.00	0.00	33374.	0.	0.00
325	6	0.00	0.00	63775.	0.	0.00
326	2	0.00	0.00	11215.	0.	0.00
705	2	28.00	14.00	13174.	184433.	0.00
706	3	61.00	20.33	28509.	579691.	121.33
707	2	30.69	15.34	4999.	76708.	227.11
708	2	9.00	4.50	8512.	38305.	40.50
712	3	7.46	2.49	49385.	122829.	4.71
713	6	45.00	7.50	57492.	431188.	24.48

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
23702190.	46480232.	924147.	28.48	55.85	1.11

EFFECTIVE DEGREES OF FREEDOM= 6 STUDENTS T-VALUE= 2.45 ALPHA=0.05

WEIGHTS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	7.00	3.50	9255.	32394.	0.50
311	2	24.00	12.00	17903.	214834.	288.00
312	2	0.94	0.47	16281.	7632.	0.44
313	2	7.00	3.50	11147.	39015.	0.00
314	5	0.00	0.00	61748.	0.	0.00
315	6	1.00	0.17	52357.	8726.	0.17
316	2	147.29	73.64	11147.	820899.	5909.40
317	2	6.56	3.28	11620.	38128.	21.53
318	2	5.00	2.50	8715.	21787.	0.50
319	7	835.84	119.41	66477.	7937761.	23235.58
320	8	0.00	0.00	79988.	0.	0.00
321	7	0.00	0.00	73503.	0.	0.00
322	9	0.50	0.06	94648.	5258.	0.03
323	5	1.50	0.30	47020.	14106.	0.45
324	3	0.00	0.00	33374.	0.	0.00
325	6	0.00	0.00	63775.	0.	0.00
326	2	0.00	0.00	11215.	0.	0.00
705	2	9.00	4.50	13174.	59282.	0.50
706	3	18.75	6.25	28509.	178184.	17.06
707	2	14.34	7.17	4999.	35854.	46.62
708	2	4.00	2.00	8512.	17025.	8.00
712	3	2.73	0.91	49385.	44953.	0.75
713	6	12.98	2.16	57492.	124394.	1.43

TOTAL	TOTAL UPPER	TOTAL LOWER	AVERAGE MEAN	AVERAGE UPPER	AVERAGE LOWER
9600233.	19105082.	95382.	11.54	22.96	0.11

EFFECTIVE DEGREES OF FREEDOM= 6 STUDENTS T-VALUE= 2.45 ALPHA=0.05

Table 3a Stratified Analysis Witch Age Composition, Numbers per Standard Tow

WITCH GEAC 1999 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 4 1999
VESSEL 49
ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW
SUMMARY TABLE
SPECIES:SPECIES 0890
SEX:COMBINED

AGE IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	0.	0.	0.	0.00	0.00	0.00	0
3.0	0.	0.	0.	0.00	0.00	0.00	0
4.0	0.	0.	0.	0.00	0.00	0.00	0
5.0	61747.	127768.	-4274.	0.07	0.15	-0.01	6
6.0	497769.	864808.	130731.	0.60	1.04	0.16	6
7.0	2209354.	4155368.	263341.	2.65	4.99	0.32	6
8.0	6001871.	12027244.	-23502.	7.21	14.45	-0.03	6
9.0	6789528.	13730122.	-151066.	8.16	16.50	-0.18	6
10.0	5130264.	10439117.	-178589.	6.16	12.54	-0.21	6
11.0	1965539.	3884821.	46257.	2.36	4.67	0.06	6
12.0	735522.	1406513.	64531.	0.88	1.69	0.08	7
13.0	133574.	262386.	4762.	0.16	0.32	0.01	6
UNKNOWN	0.	0.	0.	0.00	0.00	0.00	0
TOTAL	23525168.	46211840.	838495.	28.27	55.53	1.01	6

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE
CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE TABLE IS LESS THAN OR EQUAL TO ZERO.
VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3b Stratified Analysis Estimated Witch Abundance Year Class Distribution: Comparison for 1998-1999

	3Ps Witch Estimates			
	"number" abundance (millions of fish)		Mean #fish/tow	
Year Class	1998	1999	1998	1999
1994	0.01	0.06	0.02	0.07
1993	0.09	0.50	0.11	0.60
1992	0.09	2.21	0.10	2.65
1991	0.47	6.00	0.57	7.21
1990	1.05	6.79	1.27	8.16
1989	1.61	5.13	1.93	6.16
1988	0.83	1.97	1.00	2.36
1987	0.39	0.74	0.46	0.88
1986	0.09	0.13	0.11	0.16

Table 4a Witch abundance estimates (thousands of fish) from GEAC surveys in NAFO Division 3Ps from 1998-1999

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999
<30	314	974	0	0
	320	1320	100	0
		Subtotal	100	0
31-50	312	272	41	15
	315	827	10	35
	321	1189	0	0
	325	944	0	0
	326	166	0	0
		Subtotal	51	50
51-100	311	317	0	752
	317	193	0	120
	319	984	1548	19271
	322	1567	0	11
	323	696	0	20
	324	494	0	0
		Subtotal	1548	20174
101-150	310	170	69	116
	313	165	290	69
	316	189	591	1828
	318	129	290	35
		Subtotal	1240	2048
151-200	705	195	244	184
	706	476	551	580
	707	74	35	77
		Subtotal	830	841
201-300	708	126	38	38
	712	731	230	123
	713	851	613	431
		Subtotal	881	592
	Total [1]		4,650	23,705

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

Table 4b Witch biomass estimates (t)
from GEAC surveys in NAFO Division 3Ps from 1998-1999

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999
<30	314	974	0	0
	320	1320	28	0
		Subtotal	28	0
31-50	312	272	15	8
	315	827	4	9
	321	1189	0	0
	325	944	0	0
	326	166	0	0
		Subtotal	19	17
51-100	311	317	0	215
	317	193	0	38
	319	984	745	7938
	322	1567	0	5
	323	696	0	14
	324	494	0	0
		Subtotal	745	8210
101-150	310	170	14	32
	313	165	101	39
	316	189	245	821
	318	129	98	22
		Subtotal	458	914
151-200	705	195	67	59
	706	476	198	178
	707	74	33	36
		Subtotal	298	273
201-300	708	126	11	17
	712	731	56	45
	713	851	188	124
		Subtotal	255	186
	Total [1]		1,803	9,600

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

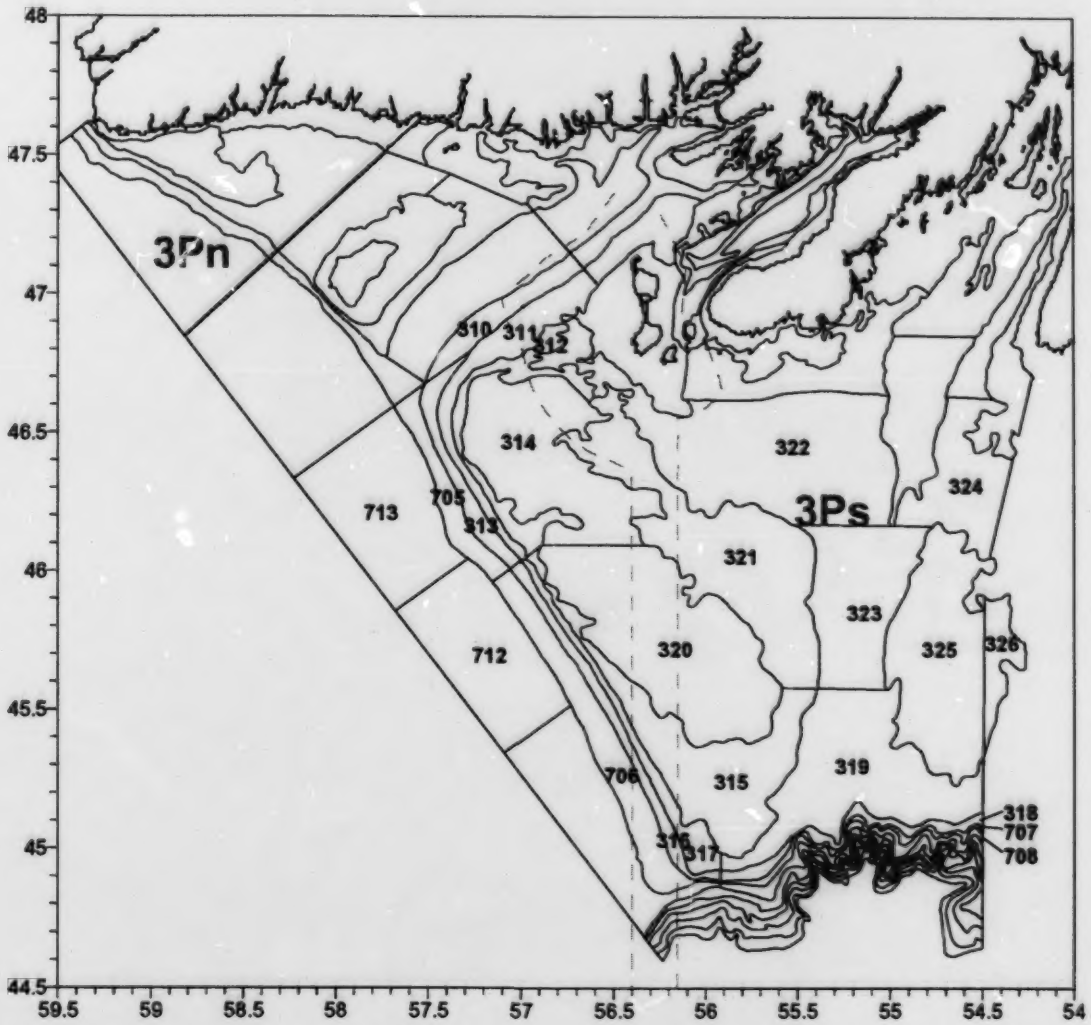


Figure 1 Stratum boundaries within NAFO Division 3Ps.
Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps.
Dashed line is boundary of French economic zone which was not surveyed.

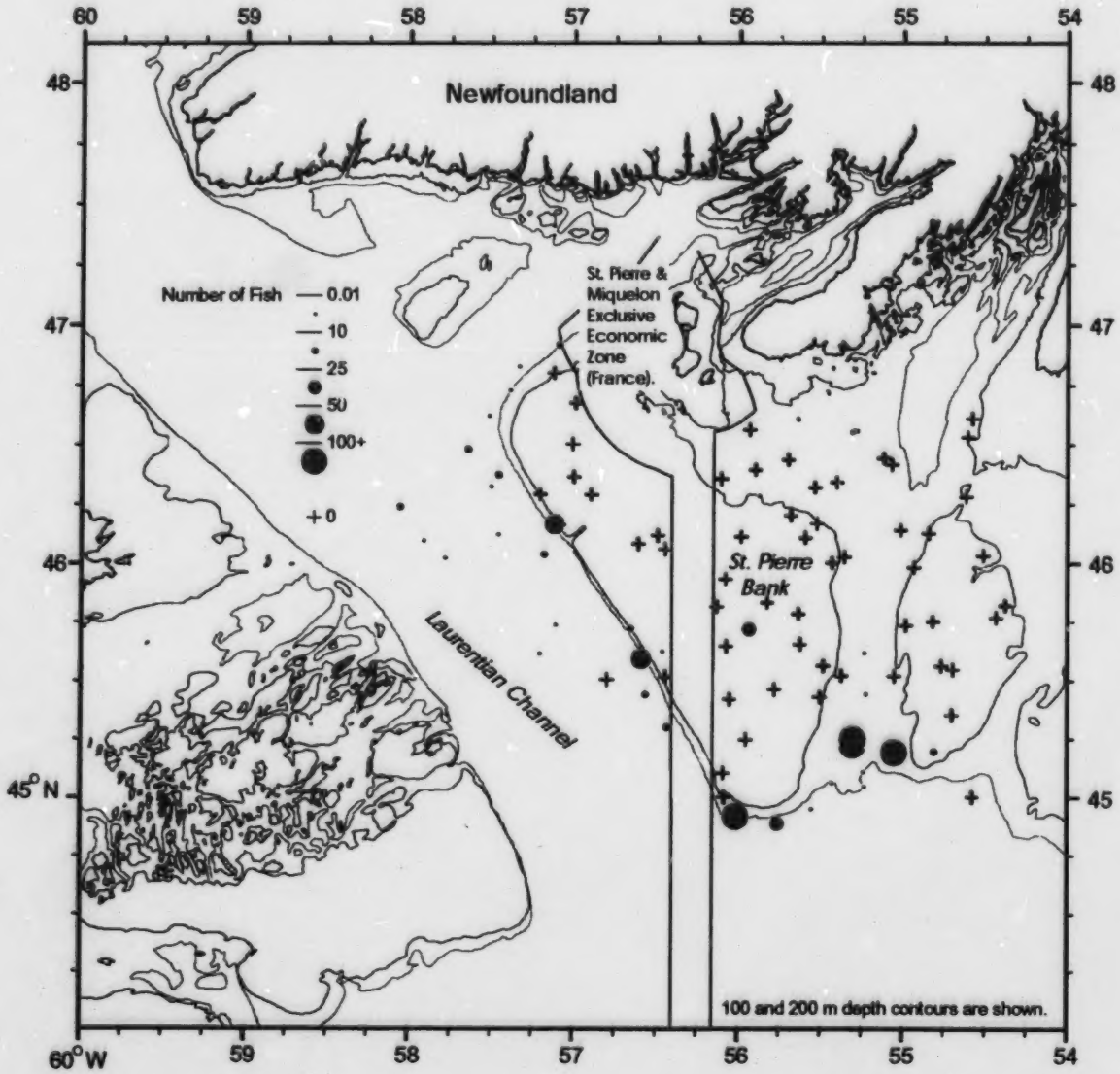


Figure 2a Witch Catch Distribution: Number of Fish, from Pennysmart Trip #4 Random Stratified Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

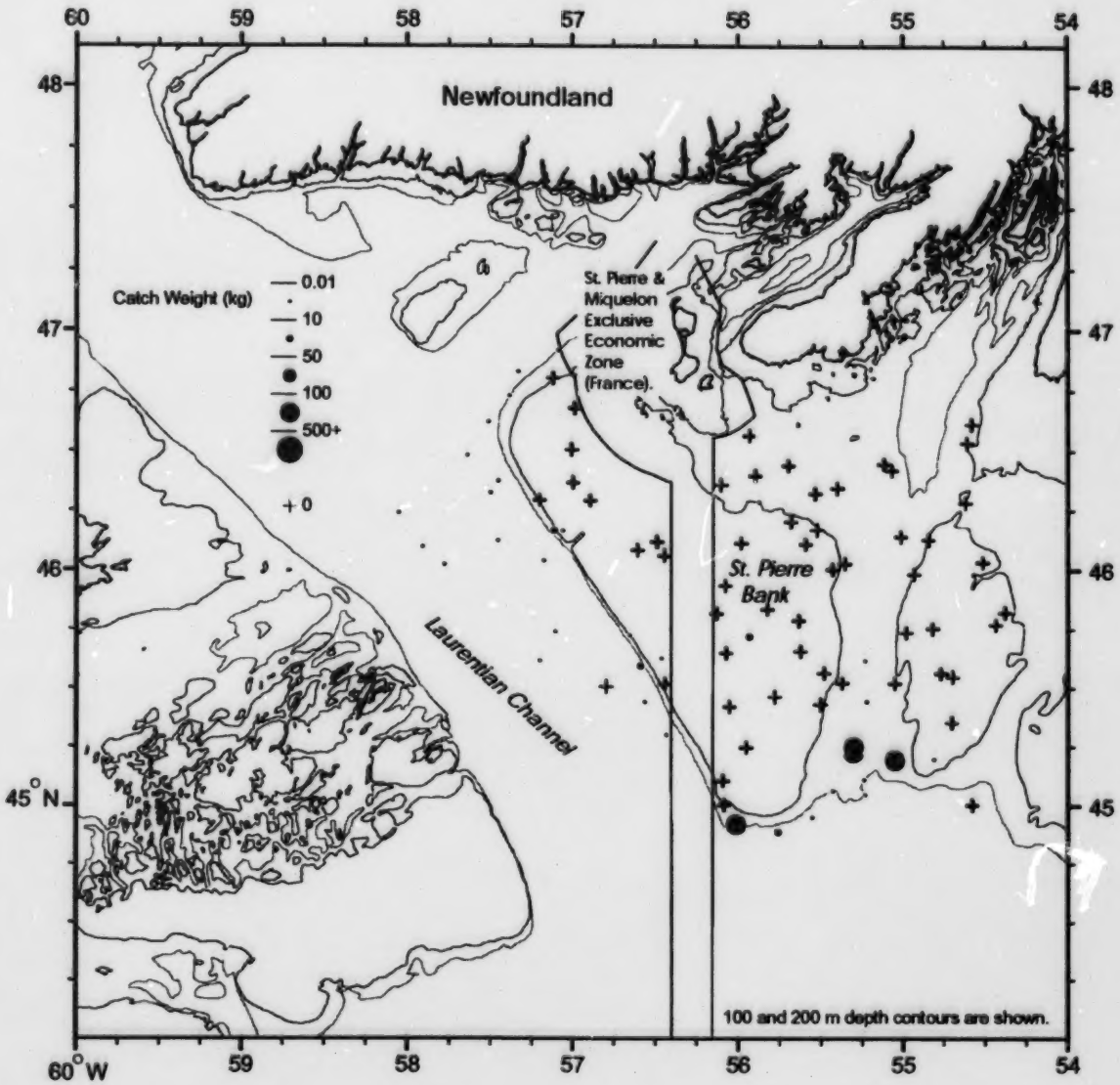


Figure 2b Witch Catch Distribution: Catch Weight, from Pennysmart Trip #4 Random Stratified Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

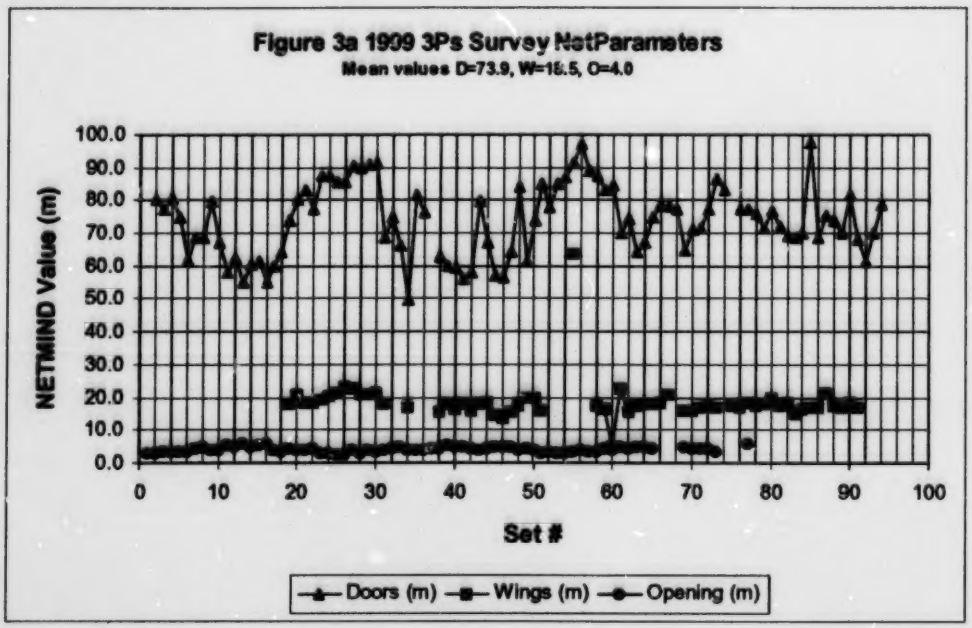


Figure 3a 1999 3Ps Survey NetParameters
Mean values D=73.9, W=15.5, O=4.0
NETMIND Value (m)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
10
20
30
40
50
60
70
80
90
100
Set #
Doors (m)
Wings (m)
Opening (m)

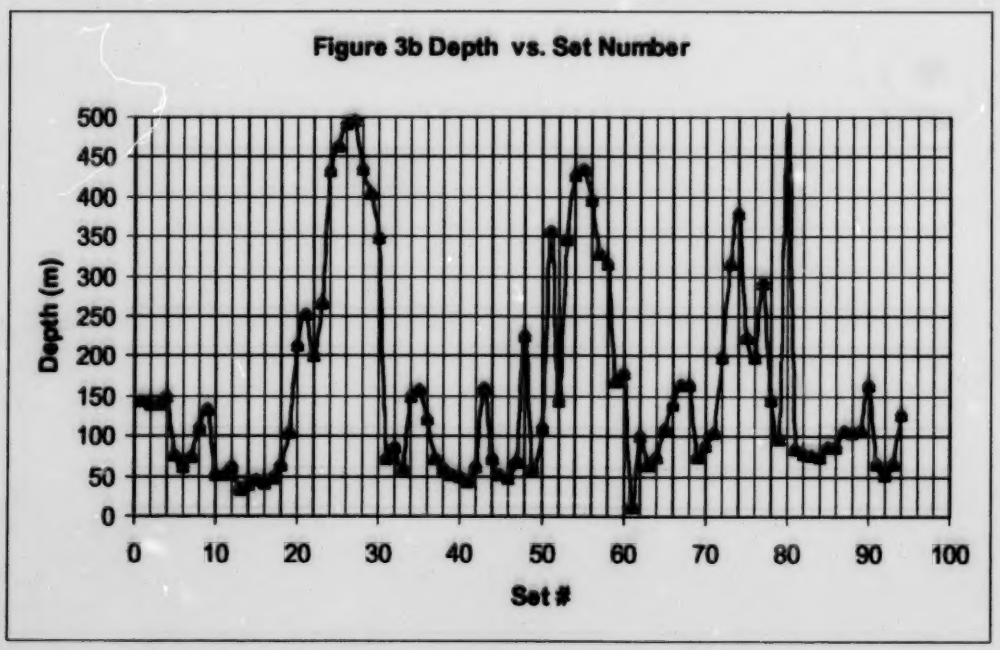


Figure 3b Depth vs. Set Number
Depth (m)
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Set #

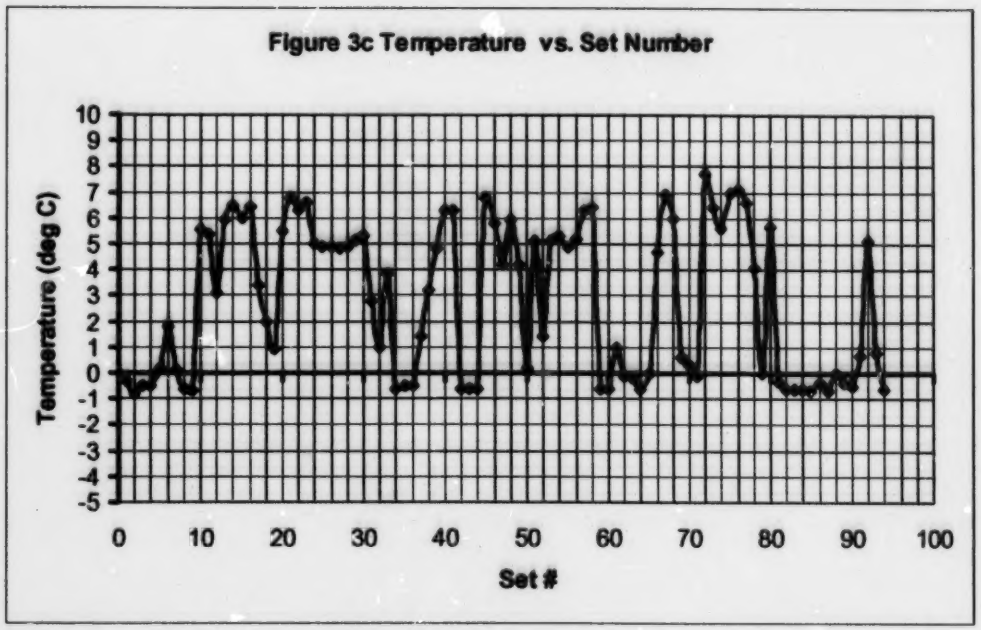


Figure 3c Temperature vs. Set Number
Temperature (deg C)
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
10
20
30
40
50
60
70
80
90
100
Set #

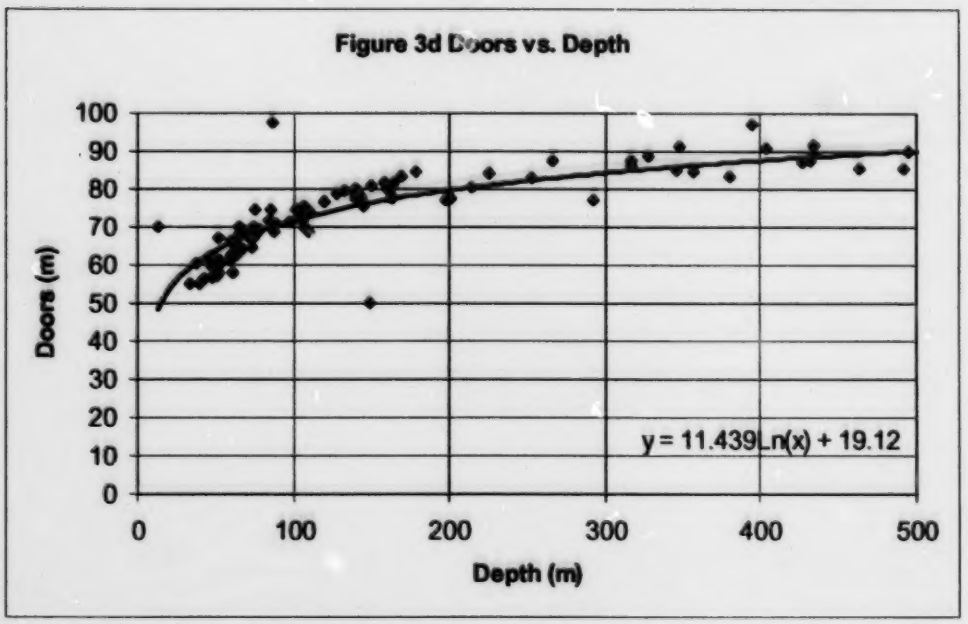


Figure 3d Doors vs. Depth
Doors (m)
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
Depth (m)
y = 11.439Ln(x) + 19.12

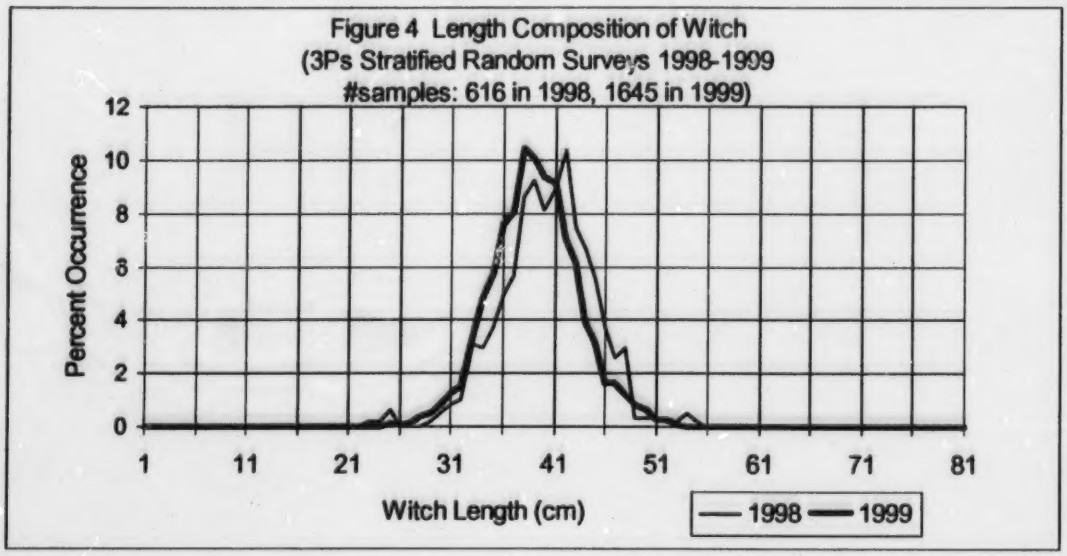


Figure 4 Length Composition of Witch
(3Ps Stratified Random Surveys 1998-1999
#samples: 616 in 1998, 1645 in 1999)
Percent Occurrence
0
2
4
6
8
10
12
1
11
21
31
41
51
61
71
81
Witch Length (cm)
1998
1999

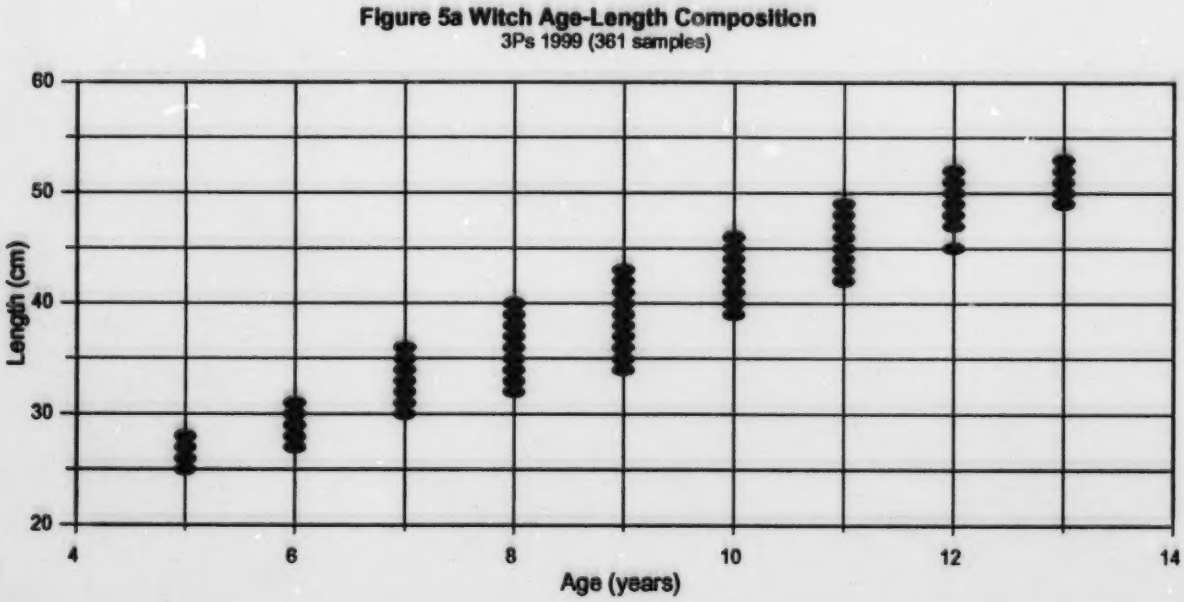


Figure 5a Witch Age-Length Composition
3Ps 1999 (361 samples)
Length (cm)
20
30
40
50
60
4
6
8
10
12
14
Age (years)

Figure 5b Age Composition of Witch
3Ps Sampled Witch

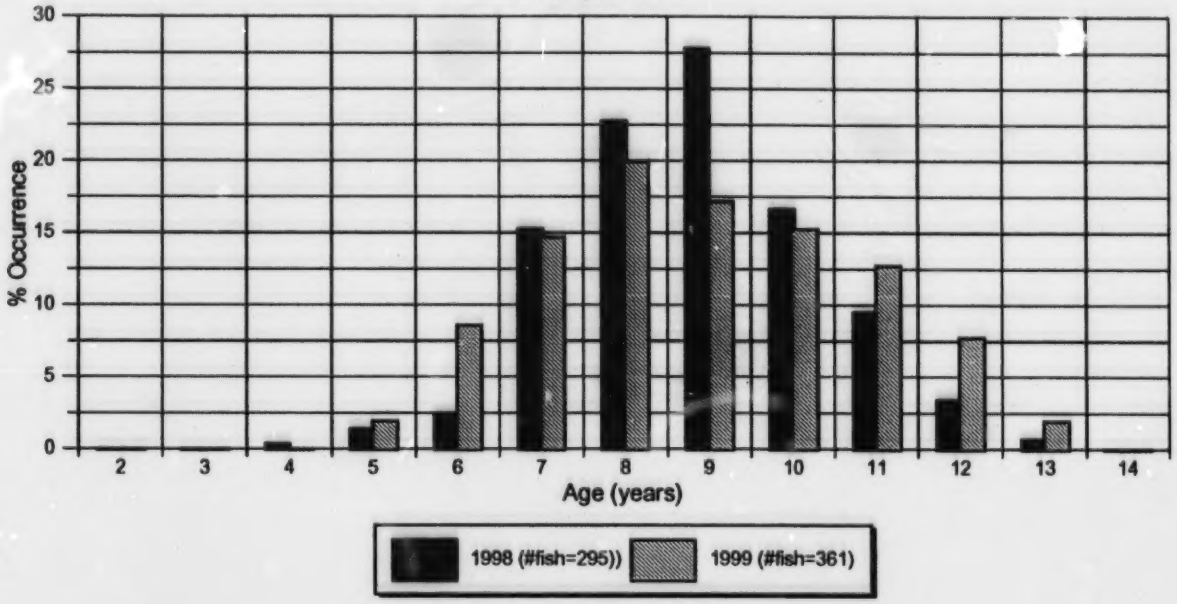


Figure 6a Age Composition of Witch
Estimated Mean #s per tow (3Ps)

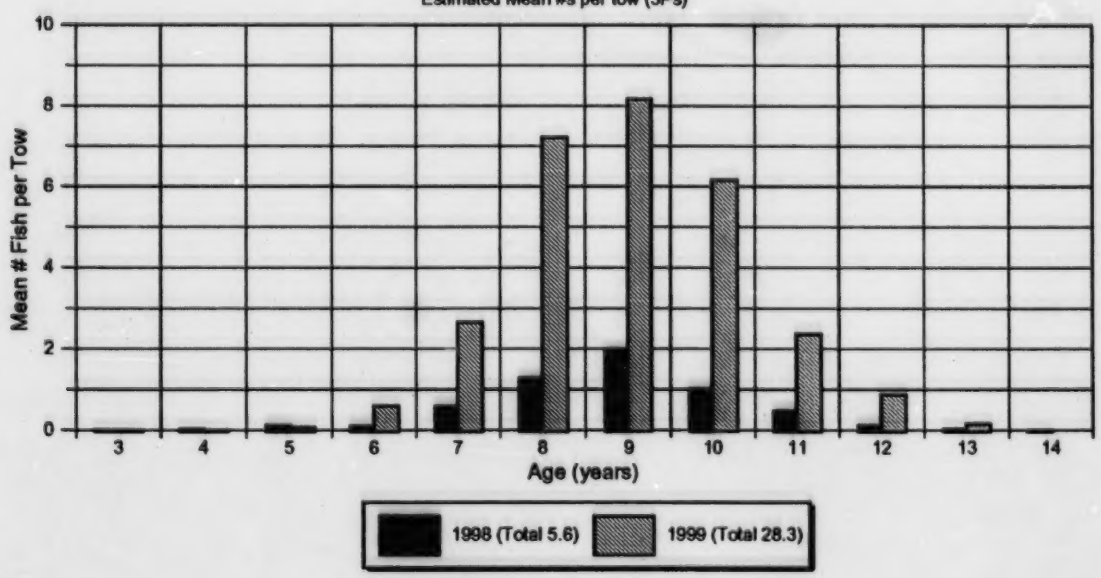
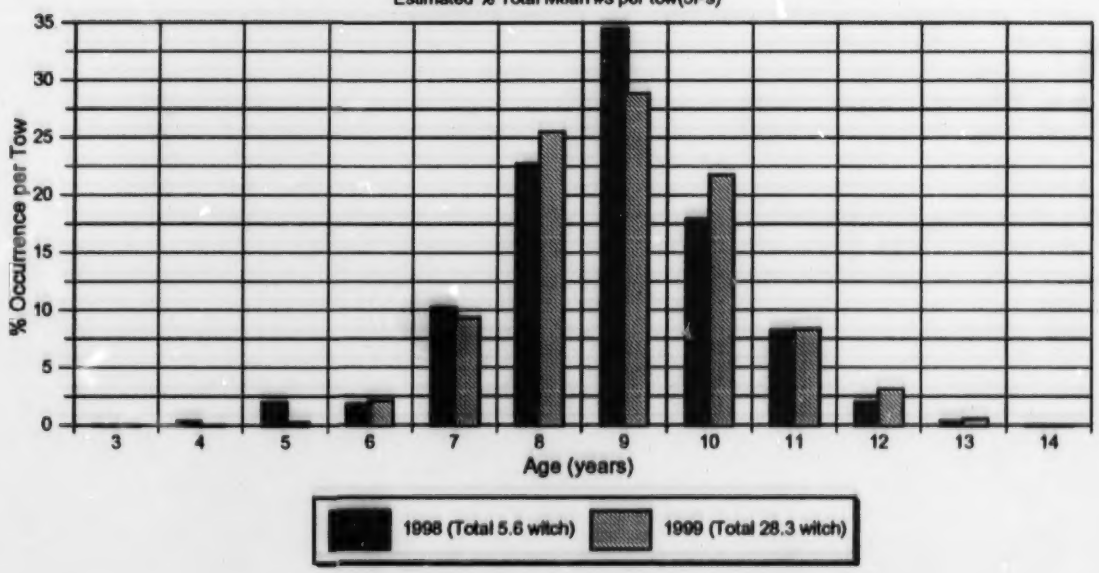


Figure 6b Age Composition of Witch
Estimated % Total Mean #s per tow(3Ps)



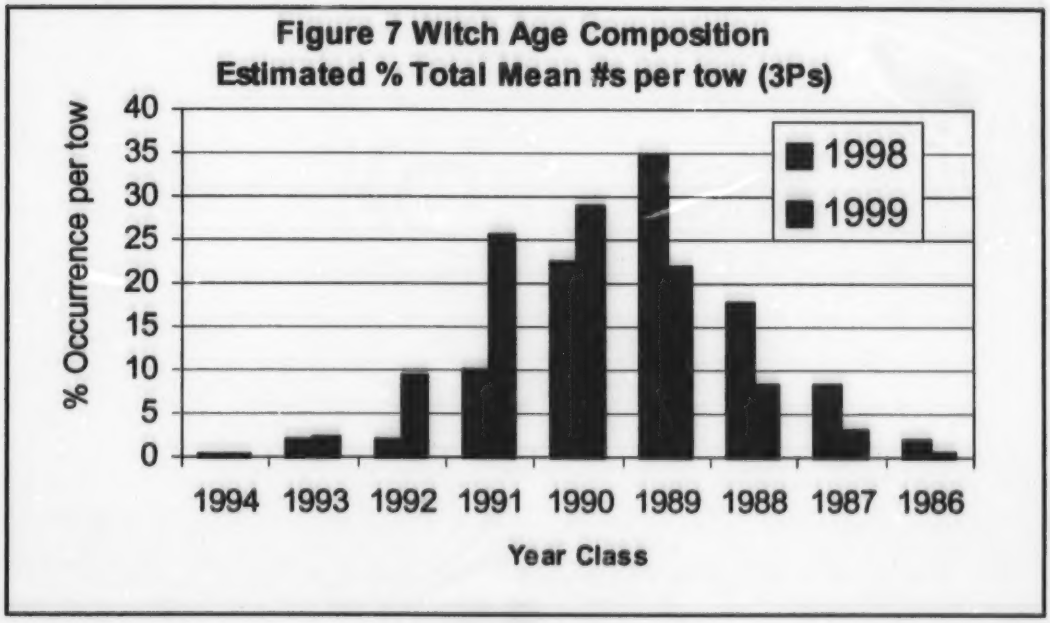


Figure 7 Witch Age Composition
Estimated % Total Mean #s per tow (3Ps)
% Occurrence per tow
40
35
30
25
20
15
10
5
0
1998
1999
1994
1993
1992
1991
1990
1989
1988
1987
1986
Year Class